

VEHICLE

INCORPORATION BY REFERENCE

[0001] The disclosure of Japanese Patent Application No. 2018-235715 filed on Dec. 17, 2018 including the specification, drawings and abstract is incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a vehicle of which all the wheels can be steered, particularly to a vehicle equipped with a device that can steer all the wheels so as to cause the vehicle to travel laterally or rotate on the spot.

2. Description of Related Art

[0003] Common four-wheel vehicles are configured such that steering wheels (usually front wheels) supported by a suspension are steered by a steering linkage. Since the steering wheels when steered may interfere with the steering linkage etc., the steering angles of the steering wheels are mechanically limited. In contrast, for example, the small vehicle described in Japanese Patent Application Publication No. 2012-232713 includes a steering actuator for each wheel, and is configured to allow each wheel to be steered to about 90 degrees or larger angles. Equipped with such a special steering device, this type of vehicle can travel laterally with all the wheels steered to 90 degrees relative to the front-rear direction of the vehicle. Moreover, when four wheels are disposed at positions corresponding to four corners of a square, steering the left front wheel and the right rear wheel to 45 degrees rightward (clockwise) as seen from above the vehicle, and steering the right front wheel and the left rear wheel to 45 degrees leftward (counterclockwise) as seen from above the vehicle, can set an instantaneous center of motion of the rotating wheels at a central portion of the vehicle body, which allows the vehicle to rotate around this instantaneous center (perform a so-called on-the-spot rotation). Simply put, the steering angle of a wheel when the vehicle rotates on the spot is an angle at which the wheel orthogonally intersects a line connecting the center of rotation and the center of the wheel to each other.

SUMMARY

[0004] Common or most vehicles are vehicles having front wheels as steering wheels, and travel in a straight line (travel straight) in the front-rear direction thereof. To change the direction of travel, these vehicles turn (make a circular motion) around a point of intersection between a line that is drawn perpendicularly from a grounded point of the steered front wheel to a plane of rotation of the front wheel and a line that is extended from the axle of the rear wheel. The structures of roads, parking lots, etc. and traffic rules are built on the assumption of such a manner of traveling of vehicles, and of course, not only drivers but also pedestrians are accustomed to such a manner of traveling of vehicles and act accordingly.

[0005] Therefore, behaviors of a vehicle such as a lateral travel, on-the-spot rotation, and straight travel in an oblique direction (oblique travel) described above are unpredictable to drivers and passengers of surrounding vehicles or pedestrians. Smooth and safe operation of vehicles is realized by

vehicles and pedestrians moving in a coordinated manner, which is premised on the assumption that the movement of each vehicle and each pedestrian is predictable. To this end, vehicles are equipped with direction indicators (right and left blinkers), backup lights, hazard lights, etc., and it is usual practice for a driver to let those around the vehicle know about the behavior of the vehicle by manipulating these devices.

[0006] However, travels or behaviors such as a lateral travel, on-the-spot rotation, and straight travel in an oblique direction described above are those that a vehicle having either front or rear wheels as steering wheels cannot perform. This means that even when the driver of such a special vehicle turns on the direction indicator, behaviors such as a lateral travel, on-the-spot rotation, and oblique straight travel are still unpredictable to nearby vehicles, including oncoming vehicles and vehicles traveling side by side with the special vehicle. Therefore, even when the drivers of the nearby vehicles, on seeing the direction indicator etc., manipulate their vehicles so as to avoid collision, this collision-avoiding manipulation may not be adapted for a lateral travel, on-the-spot rotation, oblique straight travel, etc. Then, those vehicles would rapidly approach the special vehicle or the drivers of those vehicles would have to apply the brakes suddenly, which could consequently hinder smooth and safe operation of vehicles on the road. Moreover, since a lateral movement, on-the-spot rotation, oblique straight travel, etc. are movements that are unpredictable to pedestrians, such travels or behaviors could surprise or frighten pedestrians.

[0007] The present disclosure provides a vehicle equipped with a special steering device that allows the vehicle to perform so-called special travels, such as a lateral travel and an on-the-spot rotation, and capable of ensuring smooth and safe operation of vehicles even when traveling among other vehicles that have either front or rear wheels as steering wheels.

[0008] A vehicle according to one aspect of the present disclosure includes a plurality of wheels, a steering device, and a direction indication system. The wheels are mounted to a vehicle body and configured to be grounded. The steering device is configured to steer the wheels to such a steering angle that the vehicle travels straight in a front-rear direction of the vehicle, and additionally to steer the wheels at least either to such a first steering angle that the vehicle travels straight in a direction intersecting the front-rear direction or to such a second steering angle that the vehicle rotates around a vertical axis passing through a central portion of the vehicle body. The direction indication system is configured to, when the steering device steers the wheels to either the first steering angle or the second steering angle, indicate toward the outside of the vehicle body that the vehicle is going to travel straight in a direction intersecting the front-rear direction or that the vehicle is going to rotate around the vertical axis passing through the central portion of the vehicle body.

[0009] In the vehicle according to one aspect of the present disclosure, the direction indication system may include a detection unit that detects that the steering device steers the wheels to the first steering angle or the second steering angle, and an indication unit that optically or acoustically indicates to those around the vehicle body that the vehicle is going to travel straight in a direction inter-